TECHNICAL SPECIAL PROVISIONS
FOR
CITY OF KANSAS CITY, MISSOURI
ADVANCED TRANSPORTATION MANAGEMENT SYSTEM (ATMS)

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The following requirements are intended to supplement the City of Kansas City, Missouri TSS-500B specifications except as noted below. Refer to the TSS-500B latest edition, for additional requirements.

SECTION 1 - SCOPE OF PROJECT

The work under this Contract consists of furnishing and installing all equipment and materials necessary for the installation of the Kansas City, Missouri Advanced Transportation Management System (ATMS). The primary functions of the system are to control traffic in a safe and optimized manner and to reduce motorist stops and delays. This system provides centralized signal timing database and plan selection from an event scheduler (time-of-day/day-of-week). The system will also provide system detector data analysis and equipment monitoring features including automatic system activity logging for future use.

The communications subsystems to be furnished and installed by the Contractor shall include all field electronic elements; lightning and surge protection elements; and user-owned fiber optic cable as defined in the Plans; and all auxiliary cabinets, hardware and wiring incidental to the transmission of data between the traffic control computers and the field locations.

The Contractor shall assume full responsibility for ensuring the successful construction and proper operation of the system components. The Contractor shall be fully responsible for all hardware design, testing, training and documentation as detailed in this Technical Special Provision. Also, the contractor shall be fully responsible for maintaining all existing traffic signal equipment from the date of the construction until all the signal equipment identified is removed and delivered in good condition to 5310 Municipal Ave.

This Technical Special Provision provides detailed operational and technical requirements for specific elements of the signal system necessary to satisfy the objective of this project. Elements of the signal system include but, are not limited to the following:

- Communications Cable and Equipment
- Controller and Cabinet Assemblies

- Detection Equipment and
- other traffic signal infrastructure included in the project

All special features that are required by this Technical Special Provision and the City's additional requirements at the time of bid letting shall be complied with by the Contractor. Some intersections will be under construction or will have been widened and/or improved between the times the Plans were prepared and the Notice to Proceed was issued. If these changes result in a reduced workload for the Contractor, it shall not constitute additional compensation. The Contractor shall anticipate such improvements and at some intersections, quantities may be reduced, resulting in an "under-run".

1.1 Communications

The Contractor shall furnish and install a communications network to allow the central computer to exchange data with the intersection controllers. The Contractor shall furnish and install the cable network between some of the intersections. The cable network shall consist of fiber optic communications cable and equipment installed underground in conduit as shown on the Plans and as specified herein.

The Contractor shall furnish and install Ethernet Switches inside the controller cabinets shown in the Plans and as specified herein. The Ethernet Switches shall be connected to the cable network or wireless network, wired to the controller assembly, conflict monitors and made operational in accordance with this Technical Special Provision.

1.2 Traffic Controller Assemblies

The Contractor shall be responsible for furnishing and installing Model 2070LX Advanced Transportation Controller (ATC) intersection controller assemblies and 2070 1C modules at the locations shown on the Plans. The intersection controller assemblies shall include new controllers, load switches and transfer relays, flashers, time switches, IP based conflict monitors, cabinets and all harnesses and wiring as specified herein. They shall perform those functions necessary for controlling the operation of the traffic signals to safely assign the right-of-way to

vehicular and pedestrian traffic under both coordinated and isolated operation. In addition to the intersection controller assemblies, new controller foundations, power service hardware, etc., shall be installed at those locations shown on the Plans.

The 2070LX controller hardware and 2070 1C modules furnished shall meet or exceed the requirements defined by the latest version of CALTRANS 2009 TEES Specifications. The 2070LX controller firmware furnished shall be ASC/3 firmware or approved equivalent that shall meet or exceed the requirements defined by the Operation Green Light (OGL) Controller Firmware Technical Special Provisions. The 2070 LX controller firmware furnished shall be tested and certified to work on all 2070LX controllers and 2070 1C modules meeting the requirements defined by the latest version of CALTRANS 2009 TEES Specifications. Controller assembly installation shall include any integration by the Contractor that is necessary for the proper operation of the controller assembly in the signal system. The contractor will be required to provide the Linux kernel version residing on the 2070 1C module. The Linux kernel configuration shall need to meet the latest approved ATC specification.

SECTION 2 - GENERAL

To assure full and complete utilization and compliance of all equipment furnished, the Contractor shall provide support services and materials at various points in the construction, including:

- Testing as specified in Section 5.1 of this Technical Special Provision

Acceptance of each intersection shall be made after completion of the required Burn-In Period, a field inspection and testing of that intersection. The Contractor shall be fully responsible for the maintenance and care of all equipment furnished at that intersection until the time of acceptance. Acceptance of the project communication infrastructure shall be made once the contractor has demonstrated each communication line can transmit data between individual devices and the Control Center.

The equipment and materials installation shall conform to the Plans and this Technical Special Provision; Traffic Signal Specification TSS-500B of the City of Kansas City, Missouri; the Missouri Standard Specifications for Highway Construction, latest edition; the National Electric Code; and the operational guidelines in the latest version of Manual on Uniform Traffic Control Devises (MUTCD), as amended. In case of a conflict, the documents shall govern in the order established in the Missouri Standard Specifications for Highway Construction, latest edition.

The intent of this Technical Special Provision is that the work to be done under this Contract shall be neat, finished, full and complete in every detail and ready for use and operation for the purpose for which it is intended. The Contractor shall furnish all labor, tools, materials, machinery, test equipment and equipment necessary to complete the installation and operational tests of the ATMS. The cost of all incidentals, minor and miscellaneous items, work and materials for which no payment is specifically provided, and any items, work and materials not specified or shown which are necessary to complete and maintain the work shall be included in the price bid for other items in the Contract, and no other compensation will be allowed. The

Contractor shall pay all shipping costs for the equipment furnished and installed under this Contract.

2.1 Scheduling Of Work

In no case shall the Contractor install any traffic signal control equipment at a location until all material for that location is on-hand and ready for installation, unless the Engineer gives approval. Once installation of this equipment commences, the Contractor shall complete this work in a most expeditious manner. The following items shall be considered traffic signal equipment:

- Controller assemblies
- Any and all electrical connections, accessories, etc., required to ensure the operation of the above equipment.

SECTION 3 - MATERIALS

3.1 General Requirements

Throughout the entire project, all units of any one item shall be made by the same manufacturer unless otherwise approved by the City's Traffic Engineer, or his authorized representative (the Engineer).

The equipment, including all parts and accessories, shall be constructed in a thoroughly competent manner and in accordance with best commercial practices. Particular attention shall be given to neatness and thoroughness of soldering, wiring, welding and brazing, plating, riveting, finishes and machine operations. The equipment shall be free from burrs and sharp edges or any other defects that could make the equipment unsatisfactory for the operation intended.

Electrical materials shall conform to the applicable standards of the City of Kansas City, the Missouri Department of Transportation, the National Electrical Code (NEC), the International Municipal Signal Association (IMSA), the National Electrical Manufacturer's Association (NEMA), the National Safety Code (NSC), the Electronic Industries Alliance (EIA) and the American National Standards Institute (ANSI) in every case where a standard has been established for the particular article, material or equipment. Where specific standards and serial numbers are stipulated, the reference shall be construed to be the most recent standard specifications in force and in existence on the date of advertisement.

All Contractor submittals shall be directed to the Engineer. If necessary, the Engineer may direct the submittals to other parties for review. However, the Contractor must obtain written approval of the submittal from the Engineer prior to using the equipment being reviewed.

For all submittals, the Engineer's review of the material will be completed within 30 days from the date of receipt of the submission unless otherwise specified. The Engineer will advise the Contractor, in writing, as to the acceptability of the material submitted. The Engineer may determine that the item is approved, in which case no further action is required by the

Contractor; or the item may be partially or totally rejected, in which case the Contractor shall be required to modify the submittal as required by the Engineer and resubmit the item within 15 days. At this time, the review and approval cycle described above shall begin again.

The costs of Contractor submittals shall be included within the price paid for individual items and no additional compensation will be made.

3.2 Material and Equipment List

Prior to the approval of any components or material related to the project items listed in Table 2, and no more than 60 days after contract award, the Contractor shall submit to the Engineer three copies of a Material and Equipment List. The Material and Equipment List shall identify the quantity, manufacturer, description, catalog number or other identification, and options and special features for each item furnished. A unique identification number shall be indicated for each item on the Material and Equipment List.

TABLE 2: MATERIALS AND EQUIPMENT LIST

STANDARD TRAFFIC CONTROL COMPONENTS

Including, but not limited to:

- controller assemblies
- traffic signal cable
- conduit
- pull boxes
- electrical service assemblies including electrical service wire

SIGNAL SYSTEM – RELATED COMPONENTS

Including, but not limited to:

- fiber optic termination panels and cables
- communications equipment and cable
- lightning protection devices
- underground splice enclosures

MISCELLANEOUS

- operating manuals
- grounding material
- construction material

Copies of catalog cuts and manufacturers' descriptive literature shall be submitted with each copy of the Material and Equipment List for all manufactured items. Submittal data shall be adequate to determine if the equipment and material meet the requirements of the Plans and this Technical Special Provision. Catalog cuts shall have highlighted the submittal data to be reviewed. If the catalog cuts are not highlighted, the submittal will be automatically rejected. The Contractor shall clearly note any deviations, changes, additions or other modifications to the submittal data, which are appropriate to reflect the exact equipment, and/or material intended for use. Approval by the Engineer of the Materials and Equipment List and submittal data shall not relieve the Contractor of any of his responsibility under the Contract for the successful completion of the work in conformity with the requirements of the Plans and this Technical Special Provision.

3.3 Shop Drawings

No more than 60 days after the Contract award and prior to approval of any of the components listed herein and for any non-catalog item shown on the Material and Equipment List included as Table 2 of this Technical Special Provision, the Contractor shall submit with the Materials and Equipment List three copies of shop drawings to the Engineer for review and approval. Shop drawings shall meet the requirements of the Missouri Department of Transportation Standard Specifications and these Technical Special Provisions.

3.4 Design Approval

Design approval will be given by the City based on information submitted by the Contractor for all manufactured units of equipment utilized on the project. Design approval shall be obtained before any equipment is shipped to the project.

3.5 Documentation

The contractor shall provide documentation required as a part of the project at no additional cost.

3.5.1-Wiring Diagrams

The Contractor shall provide four sets of documentation for each device location. This documentation shall include:

- Wiring diagrams for each controller assembly, communication cable, Ethernet switch and interface panel connections.

- Wiring and equipment configuration of each collection cabinet and of each rack for device locations within facilities, including communications cable, Ethernet switch and interface panel connections.

- Inside the front door of the controller or collection cabinets and in each rack for device locations within facilities, a laminated and color-coded drawing that shows all data communications and fiber wiring diagrams for that cabinet or rack.

3.5.2-As-Builts

The contractor shall supply a complete set of As-Built drawings, in electronic (AutoCAD and Acrobat) and hard copy formats highlighting any and all deviations from the original plans. As a part of the As-Built drawings, the contractor shall provide X, Y, Z coordinates of the installed conduit at 30’ intervals, except for curves and bends in conduit that will need shorter intervals, in electronic (.crd, .dwg and .kmz) file format. Coordinates of the reference points such as fire hydrants, traffic signal cabinets, traffic signal pull boxes and curb inlets along the conduit route shall also be included. The coordinates provided shall be projected in “NAD_1983_StatePlane_Missouri_West_FIPS_2403_Feet” Coordinate System.

SECTION 4 - EQUIPMENT

4.1 Electrical Power Service Assembly

The Contractor shall install electrical power service equipment as shown in the Plans. Installation shall be in accordance with Section 902 of the Missouri Standard Specifications for Highway Construction. When replacing any electrical power service, all work shall be completed in one day and the signal shall be made fully operational by the end of the Contractor's workday.

The Contractor shall be responsible for obtaining all necessary electrical power service connections. The Contractor shall pay all related connection fees.

4.2 Conduit

4.2.1 General Requirements

The Contractor shall furnish and install underground conduit as specified in the Plans. Quantities shown in the Plans for conduit installation include all quantities of each installation type (Trenched/Bored), as determined by the contractor, necessary to install the conduit as shown in the Plans. All conduit used on this project shall be a minimum of Schedule 40. Orange color conduit shall need to be used by the Contractor for fiber optic interconnect.

The conduit shall be installed at a typical depth of 36 inches below finished grade. The Contractor may reroute proposed conduit and/or adjust proposed conduit depth to a minimum of 20 inches from grade when proposed conduit installation is near and/or in conflict with an existing underground utility line and as directed by the Engineer. The conduit depth shall be adjusted only in the area of the conflict.

All new conduit installed and all existing conduit used under this Contract shall be blown and/or rodded clean to the satisfaction of the Engineer prior to the installation of any cable or wire in that conduit.

All conduit installed without conducting cable shall have a tracer wire and pull string installed. The tracer wire shall be a #10 AWG stranded USE or THHN copper locating cable. This cable will be used in all new conduits, as well as all existing conduit with new fiber being installed. The tracer wire installed is considered incidental to the installation of the fiber and conduit.

All underground conduit installed by open trenching methods shall be identified by conduit identification tape. Identification tape shall be minimum two inches wide and be of a plastic-based non-deteriorating non-color-fading material. The tape shall contain a means of being located by a metallic cable detector. Identification tape shall be colored in accordance with American Public Works Association orange for communications and shall be continuously emblazoned with black non-fading ink with the message "CAUTION TRAFFIC SIGNAL CABLE BURIED BELOW" in minimum one-inch high block letters. Identification tape shall be installed for the entire length of conduit(s) installed in trench. One length of identification tape shall be installed for all parallel conduits within one trench. The identification tape shall be continuous from conduit termination point to termination point and shall enter pull boxes with the conduit. The identification tape shall be at a depth of 12 inches above the installed conduit.

Sidewalk restoration shall be full width by section for all sidewalks five feet wide or narrower. For sidewalks seven feet or wider, the restoration may be in half-width sections or to the nearest existing seam or joint as approved by the Engineer. Sidewalks between five feet and seven feet wide may be replaced to the nearest seam or joint only if existing and approved by the Engineer.

Aesthetic sidewalk and/or pavement (brick, brick paver, paver block, colored concrete, granite, slate, etc.) shall be replaced entirely by the Contractor and shall match color and texture in accordance with the City's or owner's requirements.

Conduit entrances into base-mounted controller cabinets through the sides, back or top of the cabinet are not permitted.

Underground conduit shall generally be installed in non-pavement areas if possible. The Contractor shall install underground conduit in the grass utility strip if such a strip is available.

Quantities shown for under-pavement conduit installation shall generally mean that non-pavement installation is not possible, such as under roadways, driveways, sidewalks, etc. The open trench shall be in accordance with the Trenched Conduit Installation detail in the Plans.

The Contractor is responsible for sizing the conduit to be used on all installations in accordance with the minimum conduit size requirements in the Plans and this Technical Special Provision. The conduit shall be of sufficient size to allow the conductor to be installed without any damage. The conduit sizes and fill requirements shall conform to the requirements of the National Electric Code.

New conduit to contain electrical power service wire from the electrical service feed point to the service disconnect and from the service disconnect to the controller cabinet shall meet the minimum conduit requirement size. This conduit size must be coordinated with the power supplier. The minimum size of any new conduit installed under this Contract shall be two inches. The cost of providing as-builts shall be incidental to the installed conduit price.

4.2.2 Conduit Installation Into Existing Pull Boxes

All conduits shown in the Plans to be installed into existing pull boxes shall be installed in accordance with the requirements for conduit installation into new pull boxes. The Contractor shall maintain the existing pull box and shall restore the surrounding area to a condition equivalent to that prior to when work began. The Contractor shall immediately notify the Engineer if the Contractor determines that the existing pull box is unacceptable for reuse. If the existing pull box needs to be temporarily removed or otherwise disturbed for the new conduit installation, new gravel shall be installed in the base of the reinstalled existing pull box as required for new pull boxes.

The costs of all labor, materials and equipment necessary to complete the installation of new conduit into existing pull boxes as required in this Technical Special Provision shall be included in the quantities shown in the Plans for conduit.

The costs of all labor, materials and equipment necessary to complete the installation of new conduit into existing foundations as required in this Technical Special Provision shall be included in the quantities shown in the Plans for conduit installation.

The cost of pavement, base, sub-base, restoration of sidewalk, driveway and curb restoration shall be included in the under-pavement conduit.

4.3 Controllers

All controller assemblies furnished and installed shall meet Model 2070LX Advanced Transportation Controller (ATC) standards for controllers as defined by latest version of CALTRANS 2009 TEES Specifications. Controller assembly installation shall include any integration by the Contractor that is necessary for the proper operation of the controller assembly in the signal system. The contractor shall provide a 2 year (minimum) warranty for the 2070LX controllers and firmware from the date of completion of the project

4.3.1 Controller Access

Access to existing controllers shall be achieved via either existing or new conduit. If done through existing spare conduit, the Contractor shall locate the end of the existing stub-out and install a pull box in order that new conduit can be joined to the existing, unless the existing conduit runs to a pull box as shown in the Plans. Where shown in the Plans or where spare conduit stub-outs are not available for use, new conduit shall be installed into existing foundations. Conduit installation into existing foundations shall be by boring of the existing foundation with an air drill or other suitable tool. When additional conduits are required, the conduit shall be a minimum of three inches in diameter. The new conduits shall be core drilled in the existing area of the foundation. The Contractor is responsible for ensuring that the existing conduits, reinforcing rods, cables in the foundation, the foundation itself or its footing are not damaged by the excavation or boring. The controller cabinet shall be protected from damage during the boring and debris caused by core drilling. The Contractor shall bore the smallest hole necessary to permit the conduit installation. Only boring straight through the foundation perpendicular to the upper surface and requiring the least amount of boring and

foundation material removal shall be permitted; boring at an angle or in two different directions meeting at a common point is not permitted. The new conduits shall be located so as not to obstruct the maintenance of equipment in the cabinet or the anchoring of the cabinet flange to the concrete foundation.

4.3.2 Existing Controller Cabinet Foundations

The Contractor shall install new controller cabinets on existing controller cabinet foundations where shown in the Plans. Existing anchor bolts shall be used only if the existing bolts are in the proper position in the pad and the bolts are securely anchored to the foundation and show no evidence of corrosion or damage. The use of existing anchor bolts must be approved by the Engineer prior to new cabinet installation.

4.3.3 Existing Ground

The Contractor shall test the existing cabinet grounding electrode at all intersections where existing cabinet foundations are to be used. The existing grounding electrode shall be used if the maximum resistance to ground is less than 25 ohms. If the existing ground does not meet these requirements, new grounding electrode shall be installed until a maximum resistance to ground measurement of 25 ohms or less is obtained. This work shall be paid for as part of the controller assembly installation.

4.3.4 Cabinet Elevation

All new controller cabinet and foundation installations shall be installed with the elevation of the base of the cabinet equal to or greater than the elevation of the center of roadway.

4.4 Conflict Monitor

The conflict monitor supplied shall be capable of communicating over an Ethernet network using IP protocols, and shall have a front-panel Ethernet port that can be connected to the Ethernet switch in the signal cabinet to allow remote user running the monitor's software to interface with any specific monitor. The conflict monitor should be equipped with a reset switch to revert back to the manufacturer default IP address. If reset switch is not available the conflict monitor shall

be equipped with a USB port for communication to determine and change the IP address. The conflict monitor shall also be capable of supporting both the 16 Channel and 18 Channel Program Cards. The conflict monitor shall be configured with a removable Datakey memory device that contains all the monitor set-up information. The contractor shall provide a minimum of 2 Datakeys with the Conflict Monitor.

4.5 332L Cabinets

In addition to meeting all requirements for a 332L cabinet as required by latest version of CALTRANS 2009 TEES Specifications except as noted herein, the cabinets shall also meet any additional requirements in City's Traffic Signal Specification TSS-500B. The new 332L cabinets shall also be equipped with an auxiliary output file to provide for a total of 18 channels, LED lighting (swivel mount LED strips located at top front, top back, bottom left and bottom right), removable door mount tray for the back door, front and back door contact closure switches wired to function without a need for a 242 unit and an additional fan. The front and back door alarms switches shall be connected to logic ground and to C1 pin 54 and C1 pin 75 to generate controller alarms. The 206L power supply unit shall have an Ethernet port. The service panel/surge suppression unit shall be installed in the cabinet as per the instructions from the engineer. Also, the cables connected to the surge suppression unit shall have a minimum 1' slack for easy removal and maintenance of the unit.

4.6 Removal of Existing Traffic Signal Equipment

At the start of construction, the Engineer shall inform the Contractor what equipment is to be salvaged and what equipment is to be disposed of. At this time, the Engineer shall inform the Contractor of the location to which the Contractor shall deliver the salvaged equipment. All materials removed shall be properly disposed of at a location provided by the Contractor as directed by the Engineer, after any salvage is completed.

All existing intersection signal cable and existing interconnect cable shall be removed if new cable is shown in the Plans. The removal of existing intersection signal cable and existing interconnect cable and hardware shall include the removal and salvage of all cable, all cable

attachment hardware (e.g., eyebolts, eyenuts, hooks, clamps, hangers, etc.), and cable splicing apparatus (e.g., aerial junction boxes, enclosures, sleeves, kits, terminal blocks, etc.).

The Contractor shall perform all cable and cable hardware removal in a manner that ensures that no damage is caused to any conduit, pole or other facility. In case of damage to cables, equipment or property, the Contractor shall immediately notify the Engineer. The Contractor shall repair all damage caused by him at his sole expense and to the satisfaction of the Engineer.

SECTION 5 – CONSTRUCTION REQUIREMENTS

5.1 Acceptance Procedures

5.1.1 Test Procedures and Documentation

The Contractor shall demonstrate in the presence of the Engineer, and/or the Engineer's representative if the Engineer so desires, that the equipment supplied and installed as part of this project functions in full compliance with this Technical Special Provision. For this purpose, a program of testing is defined. The tests can be separated into pre-installation tests, system component tests and a burn-in period followed by final inspection and acceptance. All test procedures and equipment shall be furnished and maintained by the Contractor. For these tests, the Contractor shall submit four copies of documentation containing proposed test procedures, test equipment, report forms and expected results to the Engineer for review and approval at least 45 days prior to performing any test. The test plan will be reviewed by the Engineer, who shall either approve or indicate changes that are required for approval within 30 days of receipt. The Contractor shall submit the revised test to the Engineer within 15 days following the receipt of the review of the initial test plan. This process shall be repeated until the Engineer approves the test plan. Tests shall not be conducted without prior approval. Tests shall be performed on approved equipment using approved test procedures. The Contractor shall notify the Engineer at least 15 days in advance of the times and places which the tests will take place to enable the Engineer to witness them. The Contractor shall perform the tests and document the test results. When the tests are completed, whether successful or not, four copies of the test results shall be furnished to the Engineer for evaluation. The documented test results shall be self-explanatory, clearly stating how the results were obtained along with an explanation where the test results deviated from the expected results. The Engineer will notify the Contractor whether the test was successfully completed within 24 hours of receipt of the test results.

5.1.2 Inspection

All equipment and material furnished and all work performed in connection with the project shall be subject to inspection by the Engineer. The Engineer, or his authorized representative, shall have free access during normal working hours to any local facility or area in which work associated with the project is occurring. The Contractor shall ensure that full and sufficient

information concerning the character of materials and workmanship is made available to the Engineer or his representatives.

Inspection by the Engineer or his representative shall not relieve the Contractor of his obligation to comply with the requirements of the Plans and this Technical Special Provision. Any equipment or labor, which is found by the Engineer to be defective, damaged or unsuitable prior to Final Acceptance, shall be replaced or corrected at the Contractor's expense.

5.1.3 Pre-Installation Testing

2070LX Controllers, 2070 1C Modules and 332L Cabinets are subject to pre-installation tests by the City of Kansas City, Missouri Staff at a location designated by the City.

The Engineer reserves the right to withhold any payment related to the provision or installation of any piece of equipment that fails to meet the requirements of this Technical Special Provision.

In the event a pre-installation test is failed, the Contractor shall schedule a retest no sooner than 15 days following the completion of the pre-installation test for that particular equipment item.

The equipment item shall not be installed without successful completion of pre-installation tests and written approval of the Engineer.

5.1.4 System Component Tests

System component tests shall be performed on the system hardware described below. These tests shall be successfully completed prior to the start of the control section tests.

Failure to successfully complete any system component test will require the Contractor to rerun the test, in part or in whole, at no expense to the City. The Contractor shall schedule a retest no sooner than three days following notification by the Engineer of a system component test failure.

5.1.4.1-Fiber Optic Communications Cable Tests

5.1.4.1.1-Pre-installation Test

The Contractor shall test all fiber optic cable prior to installation. Cable delivered to the job site shall be tested on the reels prior to installation. This test shall consist of a single direction sweep of each individual fiber with an Optical Time Domain Reflectometer (OTDR) that has been calibrated for the index of refraction of the fiber to be tested. Verification of the fiber length and attenuation shall be made. Attenuation shall not exceed 0.56 dB/mile at 1310nm, 0.40 dB/mile at 1550nm and 0.40 dB/mile at 1625 nm. If the cable fails to meet these requirements, the Contractor shall replace the entire reel at no additional cost. Printouts of the OTDR trace with the identification of the fiber and the attenuation and length noted on the printout shall be provided.

5.1.4.1.2-Post-installation Test

After all the splices and terminations have been completed, test each fiber, including spares, with a power meter and OTDR as follows:

- Power Meter Tests: Conduct bi-directional power meter tests at 1310 nm, 1550 nm and 1625 nm for each terminated fiber to demonstrate connectivity and attenuation from cabinet to cabinet, and from origin to destination by installing feed through LC connectors at all locations where an optical device is to be connected. Demonstrate that the attenuation for each fiber path including connectors, and splices as a whole, comply with the loss budgets required by these Specifications and the optical equipment being installed. Submit a test result summary sheet of each fiber to the Engineer for review and approval. Also, provide a spread sheet with summary comparison of the loss for each of fiber tested by a Power Meter and an OTDR.

- OTDR Tests: Conduct bi-directional tests using an OTDR for each terminated fiber. Demonstrate that the attenuation for each fiber and splice, individually and as a whole comply with the loss budgets required by these Specifications. Test fibers at 1310 nm, 1550 nm and 1625 nm, using a launch cable no less than three times the pulse width used to shoot the cable. Submit OTDR traces to the Engineer for review and approval. Clearly

annotate each splice and identify the measured loss. Also, calculate and document fiber length and cable length from cabinet to cabinet, and also from origin to destination.

Those fibers that are not terminated at the time shall be uni-directional tested using a bare fiber adapter or a pigtail using a mechanical splice. The Contractor shall investigate any discontinuities and repair them or replace the cable section at no additional cost to the City. Failed splices may be remade and re-tested for compliance.

Following completion of all testing, and approval by the Engineer, the Contractor shall compile and submit organized electronic trace files on a flash memory device. Direct electronic printouts, in acrobat format or approved equivalent format, of the power meter and OTDR tests shall also be supplied. The contractor shall also provide a test summary that includes the OTDR traces of each fiber strand, and the power meter test results of each fiber strand. All traces must be organized and arranged in logical directories with a printed list of directories and filenames referenced to the fiber location provided. The contractor shall provide a sample cable verification summary worksheet for review and approval by the Engineer. The cost of the fiber testing and documentation associated with installation of a splice shall need to be included in the cost of installing the splice and the cost of the fiber testing and documentation associated with spare fibers shall need to be included in the cost of the fiber installation.

5.1.4.2-Grounding System Protection Test

The Contractor shall test the grounding of each communications termination panel. Written test results shall be provided to the Engineer prior to acceptance of the controller assembly installation. The test shall be performed from the communications termination panel surface to the cabinet grounding electrode/wire in the cabinet. Maximum allowable resistance to cabinet grounding electrode/wire shall be 2 ohms.

The Contractor shall make necessary corrections, revisions, and/or component replacements to the system control equipment assembly and any accompanying system documentation. Once the Contractor has completed all necessary corrections and revisions, the Contractor shall request in writing a retesting of the system control equipment assembly a minimum of seven days in

advance of the desired start of the retest period. The Contractor's request for a retest shall include a complete written summary of all corrections and revisions performed and, if applicable, revised system documentation. No retesting period shall commence without the Engineer's prior approval.

All retests shall be conducted in accordance with all the requirements of this section of this Technical Special Provision. The working and diagnostic demonstration of the re-test shall include the Contractor's presentation of the corrections and revisions made to the system control equipment.

If the microcomputer assembly is deemed not acceptable after completion of the first demonstration-retesting period, the Contractor shall be notified of the specific reasons for non-acceptance. All subsequent retesting shall be in accordance with all requirements for retesting.

5.1.5 Burn-in Period

A minimum 30-day burn-in period will be required for all work and equipment included in the Contract. The burn-in period shall only begin after all the communication equipment within the scope of the project has been installed and is verified to be fully functional as per the design. The burn-in period shall consist of the field operation of the Fiber Optic Communication System in a manner, which is in full accord with the traffic signal control system requirements of the Plans, this Technical Special Provision, and all other Contract Documents.

The burn-in period shall commence upon written authorization by the Engineer and will terminate after 30 consecutive days thereafter for each intersection, unless an equipment malfunction occurs. The burn-in period will be stopped for the length of time the equipment is defective. When the equipment is repaired and functions properly, the burn-in period will begin again.

Successful completion and acceptance of the burn-in period will be granted on the 30^{th} day unless any equipment has malfunctioned, in which event final acceptance will be withheld until all the equipment is functioning properly for 30 days after repair.

When a specific piece of equipment has malfunctioned more than twice during the 30-day burn-in period, the Contractor shall replace that equipment with a new unit at his cost. The Engineer will maintain records of equipment malfunctions.

5.1.6 Final Inspection

Upon completion of the burn-in period, the Engineer will make a final inspection. If all construction and all other aspects of the Plans and this Technical Special Provision are found complete, the Engineer may declare this project complete and inform the Contractor in writing of the final acceptance as of the date of final inspection.

If during the final inspection the Engineer deems any work unsatisfactory or not conforming with the Plans and this Technical Special Provision, the Engineer shall notify the Contractor in writing of any deficiencies. The Contractor shall correct these conditions within five working days, unless the Engineer grants additional time in writing. Upon completion of the Contractor's corrections, the Engineer shall conduct another final inspection. When the Engineer approves the final inspection, the Engineer shall send written notice to the Contractor of the final acceptance of the project

SECTION 6 - FIBER OPTIC CABLE

All fiber optic cable furnished and installed shall conform to these special provisions. The fiber optic cables shall provide connectivity between field networks. The Single Mode Fiber Optic (SMFO) fibers shall contain single mode (SM) window (at 1310 nm, 1550 nm and 1625 nm) fibers. Fiber optic cable shall be all dielectric cable, gel filled, duct type, with loose buffer tubes, double jacketed, single mode supplied by the same manufacturer. All fiber optic cable shall be OFNR rated indoor/outdoor loose tube cable. No splices shall be permitted within the fiber jacket. Fiber optic cable shall be imprinted with "City of KCMO, Traffic Signals, 816-513-9870" and shall be labeled with permanent, non-fading tags affixed to the cable in the traffic signal cabinet and the pull boxes.

The optical fibers shall be contained within loose buffer tubes. The loose buffer tubes shall be stranded around an all dielectric central member. Aramid yarn and/or fiberglass shall be used as a primary strength member, and flame-retardant, UV-resistant outer jacket (s) shall provide for overall protection.

All fiber optic cable on this project shall be from the same manufacturer, who is regularly engaged in the production of this material. The fiber optic cable shall be qualified as compliant with Chapter XVII, Title 7, Part 1755.900 of the Code of Federal Regulations, "REA specification for filled fiber optic cables".

6.1 Material

Each optical fiber shall be made of glass that is manufactured by Corning or licensed by Corning and consist of a doped silica core surrounded by concentric silica cladding. All fibers in the buffer tube shall be usable fibers, and shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of these specifications.

The individual fiber coating shall be a dual layered, UV cured acrylate. The coating shall be mechanically or chemically strippable without damaging the fiber.

The cable shall comply with the optical and mechanical requirements over an operating temperature range of -40° F. to +158° F. The cable shall be tested in accordance with EIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components." The attenuation shall be measured at 1310 nm, 1550 nm and 1625 nm. Fibers within the finished cable shall meet the requirements in the following table:

Fiber Characteristics Table

Parameters	Value
Mode	Single
Type	Step Index
Core diameter	8.2 µm (nominal)
Cladding diameter	125 µm ± 1.0 µm
Core to Cladding Offset	≤ 0.6 µm
Coating Diameter	245 µm ± 10 µm
Cladding Non-circularity defined as: [1-(min. cladding dia. / max. cladding dia.)]*100	≤ 1.0 %
Proof/Tensile Test	100 kpsi, min.
Attenuation @ 1.310 nm	≤ .35dB/km
Attenuation @ 1,550 nm	≤ .25dB/km
Attenuation @ 1,625 nm	≤ .25dB/km
Attenuation at the Water Peak	≤ 2.1 dB/km @ 1383 ± 3nm (≤ 3.38 dB/mi @ 1383 ± 3nm)
Chromatic Dispersion:	
Zero Dispersion Wavelength	1301.5 to 1321.5 nm
Zero Dispersion Slope at zero dispersion wavelength	≤ 0.092 ps/(nm²*km)
Maximum Dispersion:	3.3 ps/(nm*km) for 1285 - 1330 nm < 18 ps/(nm*km) for 1550 nm
Cut-off Wavelength	<1260 nm
Mode Field Diameter (Petermann II)	9.3 ± 0.5 µm at 1310 nm 10.5 ± 1.0 µm at 1550 nm

6.1.1 Color Coding

Optical fibers shall be distinguishable from others in the same buffer tube by means of color coding. The colors shall be targeted in accordance with the Munsell color shades and shall meet EIA/TIA-598A "Color Coding of Fiber Optic Cables." The color formulation shall be compatible with the fiber coating and the buffer tube filling compound, and be heat stable. It shall not fade or smear or be susceptible to migration and it shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

6.1.2 Cable Construction

The fiber optic cable shall consist of 96 fibers as shown in the Plans, arranged in 8 color-coded buffer tubes. The fiber optic cable shall consist of, but not be limited to, the following components:

A. Buffer tubes
B. Central member
C. Filler rods if needed
D. Stranding
E. Core and cable flooding
F. Tensile strength member
G. Ripcord
H. Outer jackets
I. Glass fibers as described above

6.1.2.1 Buffer Tubes: Loose buffer tubes shall provide clearance between the fibers and the inside of the tube to allow for expansion without constraining the fiber. The fibers shall be loose or suspended within the tubes and shall not adhere to the inside of the tube.

The loose buffer tubes shall be extruded from a material having a coefficient of friction sufficiently low to allow free movement of the fibers. The material shall be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.

Buffer tube filling compound shall be a homogenous hydrocarbon-based gel with anti-oxidant additives. It shall prevent water intrusion and migration. The filling compound shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hydroscopic and electrically non-conductive. The filling compound shall be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member by a method, such as the reverse oscillation stranding process that will prevent stress on the fibers when the cable jacket is placed under strain.

Each buffer tube shall be distinguishable from other buffer tubes in the cable by using the same color coding as specified above for fibers.

6.1.2.2 Central Member: The central member, which functions as an anti-buckling element, shall be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fibers and buffer tubes. To provide the proper spacing between buffer tubes during stranding, a symmetrical linear overcoat of polyethylene may be applied to the central member to achieve the optimum diameter.

6.1.2.3 Filler rods: Fillers may be included in the cable cross-section. Filler rods shall be solid medium or high-density polyethylene. The diameter of filler rods shall be the same as the outer diameter of the buffer tubes.

6.1.2.4 Stranding: Completed buffer tubes shall be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable shall meet mechanical, environmental and performance specifications. A polyester binding shall be applied over the stranded buffer tubes to hold them in place. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hydroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.

6.1.2.5 Core and Cable Flooding: The cable core interstices could be filled with a polyolefin based compound to prevent water ingress and migration. The flooding compound shall be homogeneous, non-hydroscopic, electrically non-conductive, and non-nutritive to fungus. The compound shall also be nontoxic, dermatologically safe and compatible with all other cable components.

6.1.2.6 Tensile Strength Member: Tensile strength shall be provided by high tensile strength aramid yarns and/or fiberglass which shall be helically stranded evenly around the cable core and shall not adhere to other cable components.

6.1.2.7 Ripcord: The cable shall contain at least one ripcord under the jacket for easy sheath removal.

6.1.2.8 Outer jackets: The 2 outer jackets shall be free of holes, splits, and blisters and shall be with minimum nominal jacket thickness of 37 mils. Jacketing material shall be applied directly over the tensile strength members and flooding compound and shall not adhere to the aramid yarn strength material. The outside jacket shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus. The jacket or sheath shall be marked with the manufacturer's name, the words "Optical Cable" or "Fiber Optic Cable", the number of fibers, "SM" or "Single Mode", year of manufacture, and sequential measurement markings in feet, every 3 feet. The actual length of the cable shall be within 1 percent of the length marking. The marking shall be in a contrasting color to the cable jacket (Yellow or White are preferred). The height of the marking shall be approximately 2.5 mm (.098 inch).

6.2 General Cable Performance Specifications

The fiber optic cable shall withstand water penetration when tested with a one-meter static head or equivalent continuous pressure applied at one end of a one-meter length of filled cable for one hour. No water shall leak through the open cable end. Testing shall be done in accordance with EIA-455-82A (FOTP-82), "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

A representative sample of cable shall be tested in accordance with EIA-455-81B (FOTP-81), "Compound Flow (Drip) Test for Filled Fiber Optic Cable". No preconditioning period shall be conducted. The cable shall exhibit no flow (drip or leak) at 176° F as defined in the test method. Crush resistance of the finished fiber optic cables shall be 220 N/cm applied uniformly over the length of the cable without showing evidence of cracking or splitting when tested in accordance

with EIA-455-41A (FOTP-41), "Compressive Loading Resistance of Fiber Optic Cables". The average increase in attenuation for the fibers shall be ≤ 0.10 dB/km at 1550 nm for a cable subjected to this load. The cable shall not exhibit any measurable increase in attenuation after removal of load. Testing shall be in accordance with EIA-455-41A (FOTP-41), except that the load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for 10 minutes.

The cable shall withstand 25 cycles of mechanical flexing at a rate of 30 ±1 cycles/minute. The average increase in attenuation for the fibers shall be ≤ 0.20 dB/km at 1550 nm at the completion of the test. Outer cable jacket cracking or splitting observed under 10x magnification shall constitute failure. The test shall be conducted in accordance with EIA-455-104A (FOTP-104), "Fiber Optic Cable Cyclic Flexing Test," with the sheave diameter a maximum of 20 times the outside diameter of the cable. The cable shall be tested in accordance with Test Conditions I and II of (FOTP-104). Impact testing shall be conducted in accordance with EIA-455-25B (FOTP-25) "Impact Testing of Fiber Optic Cables and Cable Assemblies." The cable shall withstand 20 impact cycles. The average increase in attenuation for the fibers shall be ≤ 0.20 dB/km at 1550 nm. The cable jacket shall not exhibit evidence of cracking or splitting.

The finished cable shall withstand a tensile load of 2669 N (600 lbs.) without exhibiting an average increase in attenuation of greater than 0.20 dB. The test shall be conducted in accordance with EIA-455-33A (FOTP-33), "Fiber Optic Cable Tensile Loading and Bending Test." The load shall be applied for one-half hour in Test Condition II of the EIA-455-33A (FOTP-33) procedure.

6.3 Packaging and Shipping Requirements

Documentation of compliance to the required specifications shall be provided to the Engineer prior to ordering the material.

The completed cable shall be packaged for shipment on reels. The cable shall be wrapped in weather and temperature resistant covering. Both ends of the cable shall be sealed to prevent the ingress of moisture.

Each end of the cable shall be securely fastened to the reel to prevent the cable from coming loose during transit. Six feet of cable length on each end of the cable shall be accessible for testing. The complete outer jacket marking shall be visible on this six feet of cable length.

Each cable reel shall have a durable weatherproof label or tag showing the manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the contract number, and the reel number. A shipping record shall also be included in a weatherproof envelope showing the above information and also include the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number and any other pertinent information.

The minimum hub diameter of the reel shall be at least thirty times the diameter of the cable. The F/O cable shall be in one continuous length per reel with no factory splices in the fiber. Each reel shall be marked to indicate the direction the reel should be rolled to prevent loosening of the cable.

Installation procedures and technical support information shall be furnished at the time of delivery.

6.4 Single Mode Fiber Optic Jumper

The jumpers shall meet the requirements for pigtails, but shall have a connector on each end. The second connector shall also be an LC/UPC type except where a different connector is required for compatibility with the equipment to which the jumper connects. The jumpers shall have matching light colored ends on either side to be able to discern the difference in cables. These jumpers shall also be labeled at both ends so as to designate which device they connect to next. The jumper length shall be a minimum of 6 feet.

6.5 Fiber Optic Splice Materials

At each splice point, splice organizer trays shall be provided to contain and protect the bare fibers and splices. All splices shall be protected with a heat-shrink sleeve containing a stainless steel strength rod or with a plastic enclosure with integral adhesive. The splice trays shall have a means to affix the buffer tube rigidly in place, and space and guides to allow "race tracking" of the fiber and guides to locate the splice protectors. Completed splice protectors shall be held in place with RTV silicone or adhesive tape. No more than 12 splices shall be placed in one tray.
A clear plastic cover shall be put in place on the completed tray.

6.6 Fiber Optic Connectors

All fiber optic connectors shall be LC/UPC type and shall conform to the NTT-SC and Telcordia 326 specifications for LC/UPC connectors. Any marks on the fiber core or on the cladding within a core diameter from the core shall be cause for rejection and re-termination of the fiber. The fiber strength member shall be affixed to the connector by crimp ring or by epoxy. If a crimp ring is used, it shall be crimped with a ratcheting tool that ensures correct crimp pressure. The connector reflectance shall be less than -55 Db. The completed termination shall exhibit a loss of no more than 0.5 dB per mated pair when tested with an OTDR and a standard test cable.

6.7 Underground Splice Enclosures

Underground splice enclosures will be used for cable splicing. Splice enclosures shall be designed to be easily accessible for testing and maintenance with the necessary vehicles and equipment to perform the task. The fiber optic splice enclosures shall be capable of accommodating splice organizers to facilitate fiber management and accept fiber fusion splices.

The splice closure shall provide fiber optic cable penetration end caps on one end, to accommodate at least two 96 count fiber optic cables, two 24 count fiber optic cable and two 8 count fiber optic cable. Water blocking techniques shall be used to ensure that the closure and cable entry locations do not leak when immersed in 19 feet of water for 30 days. The closure end

caps should be factory drilled to the proper diameter to accept and seal the fiber optic cable entry(ies). Cable entry locations shall accommodate an assortment of fiber optic cable outer diameters ranging from 0.45 inches to 0.55 inches (± 10 percent) without jeopardizing its waterproof characteristics. Tubular/cylindrical splice enclosures with non-corrosive metallic materials shall be utilized. All fiber optic splice enclosures shall meet the requirements of Telcordia Technologies (formerly Bellcore) GR-771-CORE and shall comply with all applicable NEC requirements.

Splice enclosures may encounter high water table conditions. Splice enclosures shall be non filled (no encapsulate), airtight and prevent water intrusion, able to maintain a minimum pressurization of 3 psi and have the capability to be reentered without requiring specialized tools or equipment. Splice enclosures shall also be supplied with all hardware necessary to provide solid mounting to wall structures. All enclosures and associated facilities provided under this Contract shall include a quality assurance/quality control inspection for materials, workmanship and compliance of the product to meet these specifications. The Contractor shall provide to the Engineer an executed Certificate of Compliance from the manufacturer indicating that the splice enclosures meet the requirements included herein.

All splice enclosures must employ a complete fiber management system consisting of splice trays and a stress relief system. Fiber shall be secured in the splice enclosures using reusable velcro cable wraps. Each closure shall be designed to accommodate future expansion and contain modular splice organizers/trays capable of handling splices in a neat and distinguishable fashion.

Spare splicing trays shall be provided to allow for an additional 120 splices in the enclosure. At the end of the reel splice location additional splice capacity is not required. Trays shall be easily attachable and accessible. Tray raceways shall include a raceway for excess fiber storage that accommodates the minimum bend radius of single-mode fiber without causing excessive signal losses due to bending or fiber damage. Splice enclosures shall have provisions for storing fiber splices and non-spliced fiber/buffer tubes.

The contractor shall be responsible for providing date and time stamped pictures of the completed splice tray and inside of the splice enclosure installed at each of the intersections.

6.8 Underground Splice Enclosure Locations

It shall be the responsibility of the Contractor to determine where underground splice enclosures are required for the termination of underground cable at the end of a cable reel. Underground splice enclosures shall not be spaced less than two miles unless otherwise approved by the Engineer. The cost of the enclosure used for this purpose shall be considered incidental to the installation of the communications cable network. Underground splice enclosures shall meet the requirements of Section 6.7 of this Technical Special Provision.

6.9 Fiber Optic Interface Panel / ITS Drop Cable

A Fiber Optic Interface Panel (FIP) / ITS Drop Cable shall be used any time that a fiber optic cable termination is made in a cabinet. The FIP shall be a compact, terminated and tested patch panel with a minimum 150’ drop cable length. The FIP shall have a mounting plate for securing it inside the traffic signal cabinet and should preferably be epoxy filled with a minimum of 12 LC/UPC type fiber optic connectors. If the FIP is not epoxy filled, it shall be mounted in an appropriate metal enclosure and secured inside the traffic signal cabinet as required by the Engineer. The drop cable shall be manufactured to the same specifications as the branch/trunk fiber supplied, with an OFNR-rated, all-dielectric cable that is UV-resistant, double jacketed and fully water-blocked. The drop cable shall have a 3.0 mm buffer tube with eight color coded fibers. LC/UPC-LC/UPC or appropriate jumpers shall connect the interface panel to the Ethernet switch. The contractor shall mount the FIP in an organized manner to meet the requirements of KCMO. Any marks on the fiber connector core or on the cladding within a core diameter from the core shall be cause for rejection of the FIP/ITS Drop cable. Drop cable shall be secured in the cabinet using reusable velcro cable wraps. The FIP / ITS Drop Cable shall meet the following specifications:

Fiber type: Single mode (1310/1550/1625 nm)

Cable length:	> 150’ (Installed minimum)
Cable rating:	Riser
Cable type:	Loose Tube
Cable bend radius:	2.8” (Installed minimum)
Maximum attenuation:	0.64 dB/mi at 1310 nm, 0.48 dB/mi at 1550 nm and 0.48 dB/mile at 1625 nm
Maximum insertion loss:	0.5 dB
Reflectance:	< -55 dB
Operating temperature:	-40 °C to 70 °C
Connector type:	LC/UPC
Number of connectors:	12 (minimum)
Connector tensile strength:	50 Lbs

SECTION 7 - SYSTEM AUXILIARIES

7.1 1000Mbps Managed Ethernet Switch

A 1000Mbps Ethernet switch is an active electronics device used to provide network connection to the traffic signal equipment in the cabinet. The 1000Mbps Ethernet switch shall have conformal coating and should have the option of Power over Ethernet (POE) functionality. The 1000Mbps Ethernet switch shall be IGMP version 2.2 or higher compliant. It shall have a minimum of 8 modular 10/100 Base-TX ports, two 10/100 Base-TX 802.3AF (POE) compliant ports and four 100/1000 Base-X SFP ports. In a ring configuration, when a 1000Mbps fiber link cut occurs between two switches, the rerouting time shall be less than 500 milliseconds.

The 1000Mbps Ethernet switch shall be installed in the traffic signal cabinet without the need for an external power supply. The 1000Mbps Ethernet switch shall support the following specifications:

Communication Protocols:	IEEE 802.3
	IEEE 802.3u
	IEEE 802.3x
	IEEE 802.3z
	IEEE 802.3ab
	IEEE 802.1d
	IEEE 802.1p
	IEEE 802.1q
	IEEE 802.1w
	Port Mirroring
	RMON
	IGMP Snooping
Features/Tools:	Console port access
	Telnet remote access

	Web browser support based on HTTP SNMP v1/v2/v3 Ping Capability to locally & remotely save logs and alarms Logs and alarms shall be stored in a non-volatile memory and shall not be lost during power cuts or soft reset RSTP (802.1w)
Simultaneous VLANs:	255
MAC Address:	8000 MAC addresses
Switching Method:	Store-and-forward
Switching bandwidth:	9.6Gbps
Port rate limiting:	Increments of 64kbps
LED:	Per Unit - Power status Per Port - Link/Activity (2 LEDs)
Cable:	10/100/1000 BaseT Cat 6 copper cable, up to 100 meters 9/125μm Single-mode 1310/1550/1625 nm fiber optic cable
SFP Transceivers:	3 X 1000 BX (bi-directional) modules, 10 km, Single-mode, LC 1 X 100 FX modules, 10 km, Single-mode, LC
Connectors:	RJ45 for 10/100 BaseT LC for 100/1000Base-FX
MTBF:	>100,000 Hours

Power:	Integrated power supply, 0.1A, 25W
Operating Temperature:	-40º to 85º C
Mounting:	19” Rack Mount

7.1.1 Installation & Configuration

The contractor shall mount the Ethernet switch in an organized manner to meet the approval of the Engineer. The Ethernet switch shall have the latest firmware and shall be connected to a fiber distribution unit via a pair of fiber patch cables. The fiber patch cables shall be LC-LC duplex single mode cables. CAT6 twisted pair jumper cables shall be used to connect IP based traffic signal equipment in the cabinet. The contractor shall provide 8 CAT6 cables, 4 fiber patch cables (4’ minimum length), three 10 km 1000 BX (bi-directional) SFP transceivers and one 10 km 100 FX SFP transceivers configurable for single mode fiber with LC connectors. The SFP modules provided shall be capable of working with existing CISCO 4507 node equipment. The contractor shall provide plastic plugs for fiber and copper ports. All cables and equipment required for end terminations and operation of the switch are considered incidental to this item and shall be included in the price for the 1000 Mbps Ethernet switch. The contractor shall configure the Ethernet switch with multiple VLAN’s and IGMP, suitable for the proposed communication network, as required by the Engineer. Also, the contractor shall label all the equipment and cables in an organized manner, and provide to the city staff an inventory containing model numbers and part numbers of equipment installed at each of the intersections.

7.2 PTZ Camera System

The contractor shall supply and install a P.T.Z camera dome system capable of working with the City’s existing OmniCast camera control system from Genetec. The camera system shall provide an IP video feed and control and operate on an open source, Linux-based platform, and including a built-in web server. The P.T.Z network camera shall meet the following specifications:

Image sensor:	1/3” Progressive Scan CCD
Lens:	4.4 – 132 mm, F1.4 – 4.6, Autofocus, Automatic Day/Night, Horizontal Angle of View: 2.2° - 62°
Minimum illumination:	Color: 0.2 lux at 30 IRE B/W: 0.04 lux at 30 IRE
Shutter time:	NTSC: 1/10 000 s – 0.25 s
Pan/Tilt/Zoom	Pan: 360° endless, 0.05 – 450°/s Tilt: 220°, 0.05 – 450°/s 30x Optical Zoom and 12x Digital Zoom, Total 360x Zoom
Video compression:	H.264 (MPEG-4 Part 10/AVC) Motion JPEG
Resolutions:	1280 X 720 to 320 X 180
Frame rate:	H.264 - Up to 30/25 (60/50 Hz) fps in all resolutions Motion JPEG - Up to 30/25 (60/50 Hz) fps in all resolutions
Video streaming:	Multi-stream H.264 and Motion JPEG
Image settings:	Wide Dynamic Range (WDR), Electronic Image Stabilization (EIS), Privacy Mask, Image Freeze on PTZ, Automatic defog, Backlight compensation
Security:	Password Protection, IP Address Filtering, User Access Log

Supported Protocols:	IPv4/v6, NTCIP, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP,TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SSH
API support:	The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications. The camera shall conform to ONVIF Profile S or higher as defined by the ONVIF organization, and shall be upgradable at any time.
Embedded applications:	The camera shall provide a platform allowing the upload of third party applications into the camera. The camera vendor shall provide a compatibility tool for the application vendor to verify the stability and performance impact of their uploaded application.
Transmission:	The camera shall allow for video to be transported over, HTTP (Unicast), HTTPS (Unicast), RTP (Unicast & Multicast), and RTP over RTSP over HTTP (Unicast). The camera shall support Quality of Service (QoS) to be able to prioritize traffic.
Video Buffer:	56 MB Pre- and Post-alarm
Casing:	IP66-rated, Aluminum Casing, Acrylic (PMMA) Clear Dome Cover Pre-mounted to Casing, Polycarbonate Sunshield
Processors and memory:	ARTPEC-3, 128 MB RAM, 128 MB Flash
Power Camera:	High Power over Ethernet, max. 60 W
Connectors:	RJ-45 for 10BASE-T/100BASE-TX PoE

Local storage:	32 GB, Class 10 SD/SDHC/SDXC Memory Card
Operating Temperature:	-40 °C to 50 °C
Startup Temperature:	-40 °C to 50 °C

7.2.1 Installation & Configuration

The color of the PTZ network camera and appropriate mounting hardware shall match the color of the traffic signal poles at the intersection. The contractor shall supply & install a regular license and a federated license for the OmniCast camera control system from Genetec, needed for each of the PTZ camera, for integration into the existing KCMO OmniCast camera control system. The bid item for a PTZ camera system shall also include supply and installation of 2 lightning protection units, up to 200' CAT5e outdoor shielded cable for connection from the cabinet to the PTZ camera, mounting hardware, camera licenses and cables needed for a fully functional PTZ camera system. Also, there shall be a slack of 15’ of PTZ camera cable in each of the pull boxes and the traffic signal cabinet. These items are considered incidental to the PTZ camera system and shall be included in the price for the PTZ camera system. The Contractor shall coordinate with KCMO staff for configuration of existing network equipment for routing of video feeds The Contractor shall mount the PTZ camera system equipment and label all the cables in an organized manner to meet the approval of the Engineer. The Contractor shall coordinate with KCMO signal staff for proper connection to the existing cabinet. Also, the Contractor shall ensure that the PTZ camera has the latest firmware and shall provide to the city staff an inventory containing model numbers and part numbers of the equipment installed at each of the intersections. The contractor shall provide a 3 year (minimum) warranty for the installed equipment from the date of completion of the project.

7.3 Thermal Video Detection System

The Contractor shall supply and install all equipment and connections necessary to provide a fully operational thermal video detection system with a TCP/IP interface. The thermal video detection system shall meet the following requirements:

- The thermal video detection system shall consist of a 320 x 240 (minimum) resolution thermal video camera, a Video Detection Processor (VDP) and Extension Modules(s) (EM) mounted on standard 170/2070 Input File(S); the VDP and EM shall be from the front of the modules and through connectors, e.g. RJ or D type; video signal from the camera(s) shall be input to the front of the VDP modules(s); and, the modules(s) shall be powered directly through the edge connector of the modules from cabinet's 24 volt power supply, and without any additional cabling/wiring. The VDP shall utilize the input file in the cabinet to provide detection inputs to the controller.
- The system shall include software that detects and counts vehicles in multiple lanes of each direction using only one video camera. Advanced Zones (AZ), Count Zones (CZ) and Detection Zones (DZ) shall be defined using only a video menu and a pointing device, to define and place zones on a video image. Separate zones will need to be configured for bike lanes. Up to 24 AZ, CZ and DZ per camera will need to be programmed by the contractor.
- The actual number of AZ, CZ and DZ shall be determined in the field by the Engineer. AZ, CZ and DZ for each lane shall be on a separate channel in the video detection module.
- The thermal video detection system shall also include equipment and cables necessary to support remote access to video detection processors via a TCP/IP interface that supports a 10/100 Base-T standard. The equipment shall also be capable of providing remote configuration and diagnostics of the video detection processors and transmitting video in MPEG 4 format via a TCP/IP interface, which can be viewed at a remote computer.

- Thermal video detection system shall include an appropriate cable assembly, which shall provide Red/Green inputs to the video detection modules. Phase status shall be displayed when video detection modules are connected to an external video monitor.
- Thermal video detection system shall also include a TCP/IP communication interface to configure thermal video cameras using a laptop or a computer at the traffic signal cabinet.
- Field of View (FOV) of the detection camera shall provide for a clear unobstructed view of the approach and shall be selected to allow for AZ, CZ and DZ. FOV and focal length selected for each approach shall need to be reviewed and approved by the Engineer.
- Thermal video camera shall use sun-safe VOx uncooled thermal sensor. Thermal video camera and video detection processors installed shall need to work seamlessly to provide for a fully functional thermal video detection system.
- Thermal video cameras shall utilize an athermalized lens and lens heater to provide sharp high-quality infrared imagery in all temperature and weather conditions and shall be capable of displaying the road surface temperature.
- The contractor shall provide a 3 year (minimum) warranty for the thermal video cameras from the date of completion of the project.
- Thermal video camera placement adjustment, setup and initial programming shall be at the direction of the manufacturer's representative and shall need to reviewed and approved by the Engineer. Unit prices for the thermal video detection system shall include all accessories, cables (including but not limited to 200' each of coax, power and communication cable), mountings, surge suppression, power supplies, etc., approved by the manufacturer, necessary for a fully functional system.
- The contractor shall ensure that the equipment installed has the latest firmware and shall provide to the city staff an inventory containing model numbers and part numbers of the equipment installed. The installed detection system shall be configured to limit the detection error range during day and night time from 0 to +3% for normal conditions and from 0 to +5% during inclement weather

conditions. Negative error or missed detections of bikes and vehicles will not be acceptable.

7.4 Thermal Video Camera

The contractor shall supply and install a thermal video camera that shall be integrated to work as a part of the existing video detection system. The thermal video camera shall be connected using cabling that is fully compatible with the existing non thermal video detection cameras and existing/proposed IP/serial video detection modules. The thermal video cameras shall meet the following requirements:

- The resolution of the thermal video camera shall be at least 320 x 240.
- The thermal video camera shall need to operate at an input voltage of 120 VAC or as approved by the Engineer.
- Thermal video cameras shall have the ability to display the temperature of the road surface within the Field of View.
- Field of View (FOV) of the thermal video camera shall provide for a clear unobstructed view of the approach and shall be selected to allow for AZ, CZ and DZ. FOV and focal length selected for each approach shall need to be reviewed and approved by the Engineer.
- Thermal video camera shall use sun-safe VOx uncooled thermal sensor. Thermal video camera shall need to work seamlessly with the existing/proposed equipment to provide for a fully functional thermal video detection system.
- Thermal video cameras shall utilize an athermalized lens and lens heater to provide sharp high-quality infrared imagery in all temperature and weather conditions and shall be capable of displaying the road surface temperature.
- Thermal video cameras shall have a communication interface for configuration and firmware updates using a laptop or a computer at the traffic signal cabinet.
- The contractor shall provide a 3 year (minimum) warranty for the thermal video cameras from the date of completion of the project.

- Thermal video camera placement adjustment, setup and initial programming shall be at the direction of the manufacturer's representative and shall need to reviewed and approved by the Engineer. Unit prices for the thermal video camera shall include all accessories, cables (including but not limited to 200' each of coax, power and communication cable to provide for a communication interface to the thermal video cameras at the traffic signal cabinet), surge suppression, power supplies mountings, etc., approved by the manufacturer , necessary for a fully functional system. The installed detection system shall be configured to limit the detection error range during day and night time from 0 to +3% for normal weather conditions. Negative error or missed detections of bikes and vehicles will not be acceptable.
- The contractor shall ensure that the equipment installed has the latest firmware and shall provide to the city staff an inventory containing model numbers and part numbers of the equipment installed.

7.5 Video Detection Processors

The contractor shall supply and install IP based video detection processors and cables necessary to support remote access via a TCP/IP interface that supports a 10/100 base-t standard. The equipment shall be capable of providing remote configuration and diagnostics of the video detection processors and transmitting video in MPEG 4 format via a TCP/IP interface, which can be viewed at a remote computer. The contractor shall supply SDLC cable assembly (or as approved), which shall provide Red/Green inputs to the video detection processors/modules. Phase status shall be displayed when video detection modules are connected to an external video monitor. The contractor shall setup Advanced Zones (AZ), Count Zones (CZ) and Detection Zones (DZ) using only a video menu and a pointing device to define and place zones on a video image. Separate zones will need to be configured for bike lanes. The actual number of AZ, CZ and DZ shall be determined in the field by the Engineer. AZ, CZ and DZ for each lane shall need to be on a separate channel in the video detection module. Detection zone placement adjustment, setup and initial programming shall be at the direction of the manufacturers' representative and approved by the engineer. The contractor shall ensure that the equipment installed has the latest

firmware and shall provide to the city staff an inventory containing model numbers and part numbers of the equipment installed. The contractor shall provide a 3 year (minimum) warranty for the installed equipment from the date of completion of the project. Unit prices for the video detection processors shall include all accessories, cables, mountings, setup and configuration etc., necessary to provide for a fully functional detection system. The installed detection system shall be configured to limit the detection error range during day and night time from 0 to +3% for normal weather conditions. Negative error or missed detections of bikes and vehicles will not be acceptable.

7.6 Radar Presence Detection System

The Contractor shall supply and install all equipment and connections necessary to provide a fully operational radar presence detection system with a TCP/IP interface, as per the Radar Presence Detector Detail shown in the plans. The radar system providing stop bar detection shall include Digital Wave Radar II ™ technology or approved equivalent to detect and report presence of vehicles in up to 6 lanes within a 90 degree field of view. The system shall include flexible lane configuration supporting real-time presence data of vehicles in motion in 6 lanes with sensor outputs for 12 channels and 12 detection zones with 2 ft. zone resolution. The system shall provide a detection range of 150 feet and shall be able to detect and report presence in curved lanes and areas with islands and medians. The system shall provide logic filters for zone output and provide a standard detector-rack contact-closure interface or via a SDLC cable interface. The contractor shall setup Count Zones (CZ) and Detection Zones (DZ). Separate zones will need to be configured for bike lanes. The actual number of CZ and DZ shall be determined in the field by the Engineer. CZ and DZ for each lane shall need to be on a separate channel in a standard detector-rack contact-closure interface or via a SDLC cable interface. Radar presence detection placement adjustment, setup and initial programming shall be at the direction of the manufacturers' representative and approved by the engineer. The system shall have the capability to provide detection data in a standard detector-rack contact-closure interface and also directly to controller through SDLC port. The system shall be mounted and installed per manufacturer's specifications and shall have presence detection zones and count zones to detect and count vehicles. Detection zones and count zones for each lane shall be assigned to a separate

channel on the rack card. Appropriate length of cable shall be installed to provide power and communications to the radar unit. The cable shall be securely and cleanly mounted in the signal cabinet as approved by the Engineer. Equipment provided shall accommodate power devices for the radar system, surge suppression, and other necessary equipment for the operations of the system. The power supply necessary for operation of the system, shall be supplied with the radar detection equipment. Radar detection system equipment located in the cabinet shall be mounted as approved by the Engineer. Unit prices for the radar detection system shall include all accessories, cables (including but not limited to 200' each of power, SDLC cable and other communication cables), mountings, setup and configuration etc., necessary for a fully functional system. Each of the intersections where radar units are proposed shall be provided with an equipment interface unit with a SDLC port. The installed detection system shall be configured to limit the detection error range during day and night time from 0 to +3% for normal weather conditions. Negative error or missed detections of bikes and vehicles will not be acceptable.

7.7 Advanced Radar Detection System

The Contractor shall supply and install all equipment and connections necessary to provide a fully operational advanced radar detection system with a TCP/IP interface, as per the Radar Detector Detail shown in the plans. The radar system providing advanced detection shall include Digital Wave Radar™ technology or approved equivalent to detect and track up to 10 vehicles by lane. The system shall include flexible lane configuration supporting real-time presence data of vehicles in motion in 6 lanes with sensor outputs for 12 channels and 12 detection zones with 5 ft. zone resolution. The system shall provide a detection range of 500 feet and report estimated time of arrival, speed and range of vehicles approaching the stop bar. The system shall provide logic filters for zone output by utilizing a standard detector-rack contact-closure interface or by utilizing a SDLC cable interface. Radar detection placement adjustment, setup and initial programming shall be at the direction of the manufacturers' representative and approved by the engineer. The system shall have capability to provide detection data in a standard detector-rack contact-closure interface and also directly to a controller through SDLC port. The system shall be mounted and installed per manufacturer's specifications. Appropriate length of cable shall be installed to provide power and communications to the radar unit. The cable shall be securely and

cleanly mounted in the signal cabinet as approved by the Engineer. Equipment provided shall accommodate power devices for the radar system, surge suppression, and other necessary equipment for the operations of the system. The power supply necessary for operation of the system, shall be supplied with the radar detection equipment. Radar detection system equipment located in the cabinet shall be mounted as approved by the Engineer. Unit prices for the radar detection system shall include all accessories, cables (including but not limited to 200' each of power, SDLC cable and other communication cables), mountings, setup and configuration etc., necessary for a fully functional system. The installed detection system shall be configured to limit the detection error range during day and night time from 0 to +3% for normal weather conditions. Negative error or missed detections of bikes and vehicles will not be acceptable.

7.8 Accessible Pedestrian Signals

Accessible Pedestrian Signals (APS) installations shall meet the most current requirements of the Americans with Disabilities Act (ADA), the Manual on Uniform Traffic Control Devices (MUTCD) and the Public Rights-of-Way Accessibility Guidelines (PROWAG). The contractor shall install the APS units as per the manufacturer guidelines and program the APS units as approved by the engineer. The installed APS units shall meet the following (minimum) requirements:

- APS equipment provided shall include the push button, control unit mountable in pedestrian signal head, signal cable, mounting hardware, connectors, one configurator/setup box and/or PC software needed to update firmware and to read/write/save configuration/audio files, and all other auxiliary equipment required to provide a complete and operational system. Contractor is responsible for completing all installation and configuration, as approved by the Engineer, to provide an operating accessible pedestrian signal system.
- Speech messages shall be patterned as per the latest version of the MUTCD, programmed and configured to be turned on/off by the user using a configurator/setup box and/or a PC. Electronic copy of speech messages and PC software license(s) needed for configuration shall be provided to City staff. Configurator/setup box and/or PC software

needed for firmware updates and to read/write/save configuration files/audio files shall be supplied with this project, and is considered subsidiary to the cost of the system.

- Where APS units are installed at least 10’ apart at all corners of the intersection, the APS units shall be configured for the following:
    - Single Push (less than 1 Second)
        - “Wait” message
        - Vibrotactile and Percussive tone to indicate Walk Interval
        - Latching pilot light
    - Extended Push (1 sec or more)
        - All options similar to a single push button press and
        - Speech push button information message
- Where APS units are installed at less than 10’ apart at any corner(s) of the intersection, the APS units shall be configured for the following:
    - Single Push (less than 1 Second)
        - “Wait” message
        - Vibrotactile and custom speech message to indicate Walk Interval
        - Latching pilot light
    - Extended Push (1 sec or more)
        - All options similar to a single push button press and
        - Speech push button information message
- Push button information message for crosswalk to median where a second button push is required should be patterned as follows:
    - “Wait to cross Briarcliff at Mulberry. Median with push button.” as per section 4E.13 of MUTCD which refers to ITE’s Electronic Toolbox for Making Intersections More Accessible for Pedestrians Who are Blind or Visually Impaired. Reference document “Determining Recommended Language for Speech Messages used by Accessible Pedestrian Signals” www.ite.org/accessible/APS_Speech.pdf.
- Push button information message for midblock crossings should be patterned as follows:
    - “Wait to cross Charlotte at 2300 Block.”

- APS units shall be programmed to set the locator tone and WALK indication to be heard within 6 – 12 feet, or to the building line whichever is less.
- KCMO pre-approved push button locator tone(s) and percussive tone(s) shall be used. Push button locator tone, audible tones, audible speech messages and speech push button information message shall be user configurable and no more than 2 - 5dBA above ambient sound.
- Automatic volume adjustment feature in response to ambient traffic sound level shall be provided up to a maximum volume of 100 Dba.
- APS units shall have a pilot light and vibrotactile WALK indications. Tactile arrows should have good visual contrast with their background.
- Speaker, microphone and vibrotactile indications should be located at the push button.
- Extended push button press shall be capable of activating additional features, including but not limited to push button information message and longer crossing time.
- A R10-3e sign (9" X 15") with street name in Braille (Grade 2) located below the direction arrow on the sign.
- All volumes, optional features, and field selectable options are to be user settable using a central control unit located in the traffic signal cabinet and via a secure USB port at the push button. The central control unit shall be secured in the cabinet as approved by the Engineer. The total linear dimension (length + height + width) of the central control unit should not exceed 17".
- When 2 APS units are installed on the same pole, proper vibratory insulation and a rubber gasket shall be used to isolate and prevent vibrations from being detected on the un-activated unit. If APS equipment is installed on a pedestrian pole/street light pole, back plate shall be installed to direct sound from the speakers towards the crosswalk and the sidewalks, if the speakers are not located on the front face of the APS units.
- Push button installations shall be based on final sidewalk grade and not based on pole grade for lowered or raised sidewalk sections.
- The control face of the push button should be installed, to face the intersection, closest to the crosswalk line farthest from the intersection, parallel to the direction of the crosswalk it serves, centered and adjacent to a level landing and, before the detectable warning. The APS units shall be installed to comply with all the requirements in the latest version of

Public Rights-Of-Way Accessibility Guidelines including, but not limited to, the unobstructed horizontal reach range of 10".

- One APS Extension Bracket to allow up to an extension length of 12" shall be provided for every 8 APS units and is considered subsidiary to the cost of the APS units. Extension brackets will need to be installed, if needed based on field conditions, to meet the PROWAG reach range requirements.
- Any manufacturer provided warranty for the equipment shall begin from the date of completion of the project.

7.9 Internally Illuminated Street Name Signs

Internally Illuminated Street Name Signs (IISNS) furnished and installed shall meet the most current requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and Standard Highway Signs 2004 Edition - 2012 Supplement except for the following specifications:

- Length of Sign: Up to 120" in 6" increments
- Height of Sign: 18" (excluding the sign housing)
- Font Type: Clearview Hwy 4-W; Font can be changed to Clearview Hwy 4-WR, Clearview Hwy 3-W or Clearview Hwy 3-WR, if sign length will exceed 120" and is approved by the Engineer
- Font Size: 8"
- Font Color: White, shall meet MUTCD legend color requirements
- Background Color: Green (3M EC Green 1177 or approved equivalent), retro reflective, shall meet MUTCD background color requirements.
- Sign Sheeting: 3M™ Electrocut™ film or approved equivalent
- Internal Illumination Source: LED or approved equivalent
- Installed Weight of Sign: Maximum of 10 pounds per linear foot, including mounting hardware.
- Pictograph/Logos: Required, Varies based on location (KCMO Parks or KCMO Fountain or CBD)
- Black End/Top/Bottom Panel Width: 2.0" (maximum)

- End/Top/Bottom/Back Panel Color: Exterior of sign housing to be powder coated black , interior of sign housing to be painted gloss white enamel finish.
- Photo Cell: Yes, to activate internal light source during dim ambient light
- Power Supply Location: Internal to the sign, shall be mounted to the side chassis of the sign and will need to be easily accessible.
- Power Supply Input Voltage: 120 VAC
- Power Supply Output Power: 100W
- Junction Box: Aluminum housing with neoprene rubber (or approved equivalent) gasket. Externally mounted to the side of the sign or built into the side of the sign housing. The mounting location shall need to provide for easy access after the installation.
- Contrast Ratio: Legend / Background contrast ratio 4:1 (minimum)
- IISNS Samples:

- Wind Load: 110 mph (minimum) with 1.14 gust factor and ice loading as per AASHTO LTS-4 2001 or later
- Electrical Certification: Listed to UL48
- Logos shall need to meet KCMO logo standards. Logo height and width shall not exceed the upper-case letter height of the principal legend of the sign. KCMO Parks logo uses PMS 376 and PMS 574 while the KCMO logo uses white color. Sun spot on the KCMO Parks logo may be omitted. **City staff will provide logo changes and/or details during the shop drawing review process**.

The Contractor shall furnish and install manufacturer recommended fasteners, safety cables and mounting brackets required to install the IISNS on curvilinear mast arms/straight mast

arms/signal poles. The color of the appropriate mounting hardware shall match the color of the traffic signal poles at the intersection. The Contractor shall supply and install 12 AWG / 3C IMSA 20-1 stranded cables and a 30A breaker for supplying power from the traffic signal cabinet to the IISNS, as approved by the Engineer. The Contractor shall be responsible for completing all installation and configuration of the IISNS, as per the plans, manufacturer guidelines, and as approved by the Engineer, to provide a fully functional IISNS. Unit prices for the IISNS shall include all accessories, cables, power supplies, mountings, etc., approved by the manufacturer, necessary for a fully functional IISNS. Any manufacturer provided warranty for the installed equipment shall begin from the date of completion of the project.

TYPICAL IISNS SIGN DETAIL:

7.10 Priority Control System

The contractor shall install Priority Control System at the intersection. The Priority Control System installed shall provide for interoperability between infrared and
GPS radio priority control technologies and at a minimum shall include the following:

- Single channel, dual detection detector mounted on the mast arm to achieve a minimum range of 1000', for each of the approaches.

- One multimode phase selector; four-channel, dual priority, multimode encoded signal device powered using 24VDC from the input file and containing built-in power supply to support the installed detectors.
- Auxiliary Interface Panel
- 1000’ of manufacturer recommended outdoor rated detector cable; three color-coded conductors, conductive shield and drain, and PVC jacket
- Software License
- Appropriate mounting hardware, accessories and cables, as approved by the Engineer

The color of the mounting hardware installed shall match the color of the traffic signal poles at the intersection. The Contractor shall supply and install manufacturer recommended outdoor rated detector cable from the traffic signal cabinet to each of the detectors, as approved by the Engineer. The Contractor shall be responsible for completing all installation and configuration of the Opticom Priority Control System, as per the manufacturer guidelines and as approved by the Engineer, to provide a fully functional Opticom Priority Control System. The contractor shall ensure that the equipment installed has the latest firmware and shall provide to the City staff an inventory containing model numbers and part numbers of the equipment installed. Unit price for the Opticom Priority Control System shall include equipment, accessories, cables, mountings, etc., setup and configuration necessary to provide for a fully functional Opticom Priority Control System at the intersection. Any manufacturer provided warranty for the installed equipment shall begin from the date of completion of the project.

7.11 Pedestrian Presence Detection System

The contractor shall install Pedestrian Presence Detection System for each of the pedestrian crossing locations. The Pedestrian Presence Detection System shall be capable of intelligently detecting pedestrian presence within a 20’ X 15’ (minimum) area adjacent to the APS unit when mounted at 15’ height. The Pedestrian Presence Detection System installed shall utilize network based system architecture and at a minimum shall include/provide for the following:

- 3D Stereovision Sensor capable of detecting normally during all weather conditions and changes in illumination, both slow changes and abrupt changes.

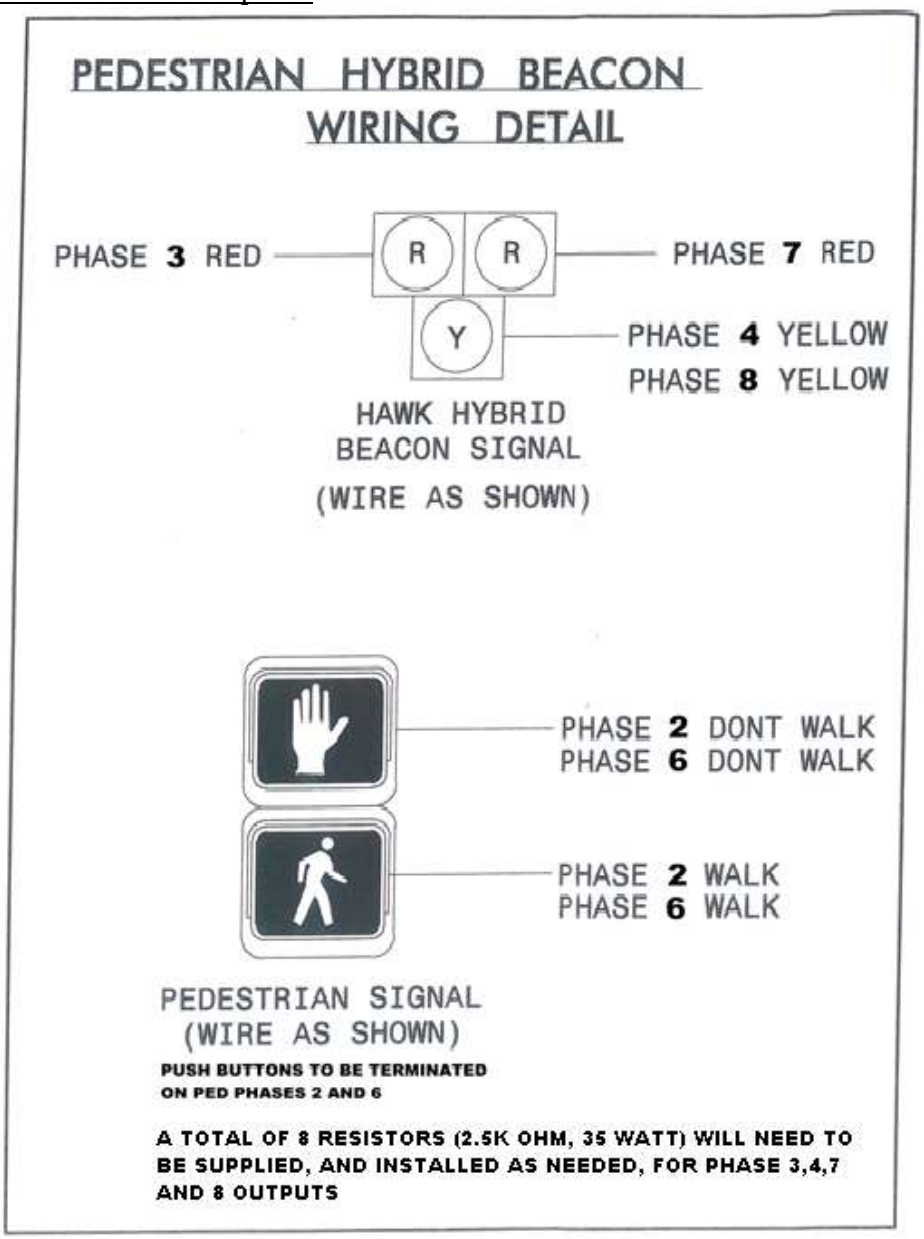
- IP-addressable and provides for remote configuration and monitoring via a native TCP/IP port
- 2 optically insulated dry contacts per sensor
- Sensor resolution of 640 X 480 (minimum)
- Wide field of view for providing a 20’ X 15’ (minimum) detectable area with a detection accuracy of 98% (minimum) at light levels down to 2 lux.
- 5 second startup time after power failure.
- Led at the sensor and the cabinet to indicate status of the system.
- Power supply and Ethernet interface board/unit.
- Capable of interfacing with Accessible Pedestrian Signals.
- 210’ of outdoor rated shielded cable CAT 5E cable. A 10’ of slack cable shall be available in each of the pull boxes and the signal cabinet.
- Appropriate mounting bracket so as to achieve a plan view of the detectable area

The Contractor shall supply and install manufacturer recommended outdoor rated Cat 5E cable from the traffic signal cabinet to each of the sensors, as approved by the Engineer. The Contractor shall be responsible for completing all installation and configuration of the Pedestrian Presence Detection System, as per the manufacturer guidelines and as approved by the Engineer, to provide a fully functional Pedestrian Presence Detection System. The contractor shall ensure that the equipment installed has the latest firmware and shall provide to the City staff an inventory containing model numbers and part numbers of the equipment installed. The Contractor shall mount the equipment and label all the cables in an organized manner to meet the approval of the Engineer The contractor shall provide a 3 year (minimum) warranty for the installed equipment from the date of completion of the project. Unit price for the Pedestrian Presence Detection System shall include equipment, accessories, cables, mountings, etc., setup and configuration necessary to provide for a fully functional Pedestrian Presence Detection System for each of the pedestrian crossing locations. The installed detection system shall be configured to limit the detection error range during day and night time from 0 to +3% for normal weather conditions. Negative error or missed detection of pedestrians will not be acceptable. Any manufacturer provided warranty for the installed equipment shall begin from the date of completion of the project.

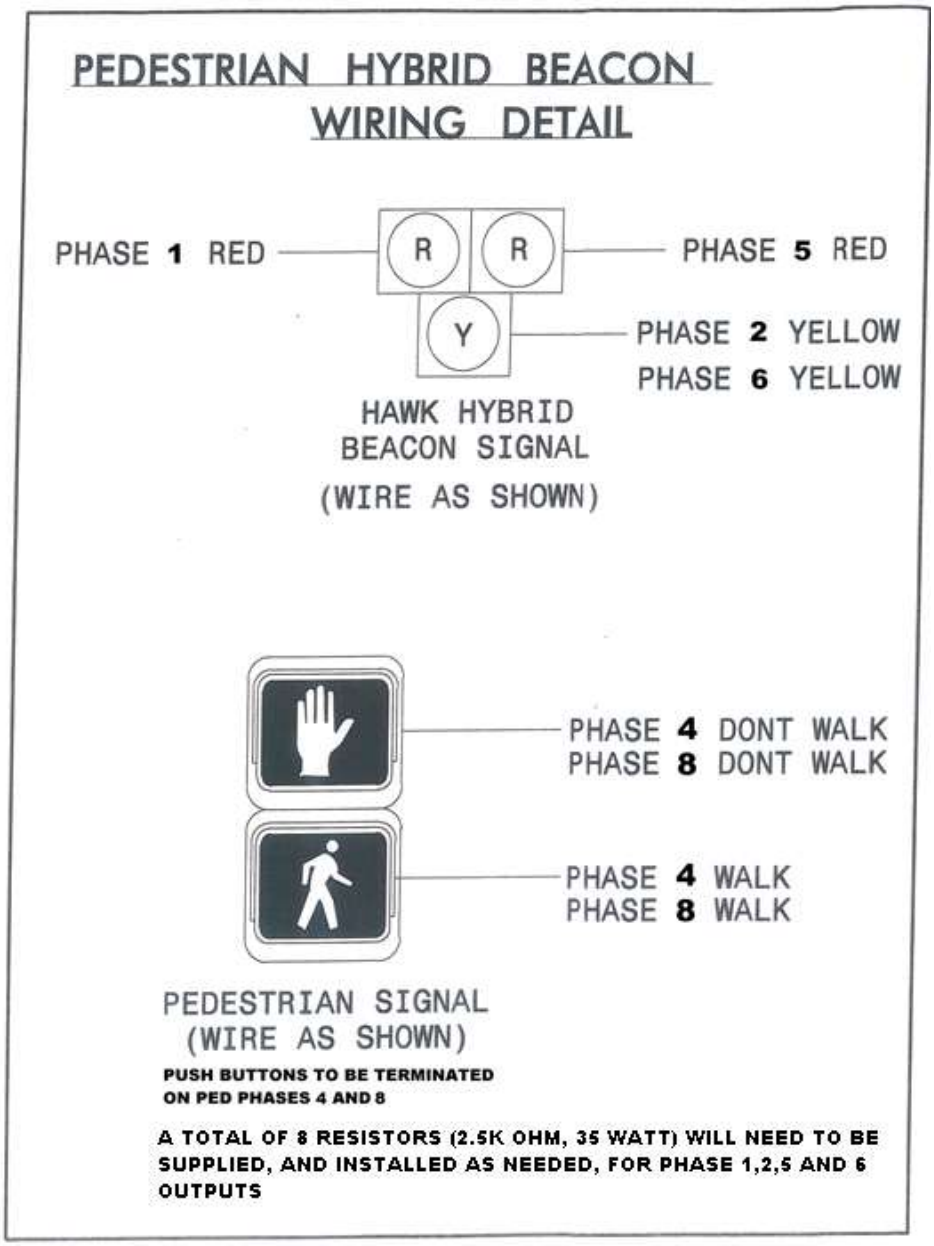
7.12 Pedestrian Hybrid Beacon/Hawk Signal Wiring Templates

The contractor shall supply 8 resistors (2.5K Ohm, 35 Watt) for each traffic signal cabinet. The resistors supplied and installed for the phase outputs shall be secured in the cabinet so as to minimize the possibility of shorting and to minimize the impact of the heat generated on wiring and equipment in the cabinet. Also, installation should allow for efficient heat dissipation. Refer to the following schematics for wiring templates at Pedestrian Hybrid Beacon/Hawk signals:

North – South Template:



East – West Template:



7.13 Remote Power Switch

The Contractor shall supply and install a 1U, 4 outlet (minimum) remote power switch as approved by the Engineer. The switch shall have surge protection and shall provide secured remote power source management operation and AC current monitoring via TCP/IP interface. Any manufacturer provided warranty for the installed equipment shall start from the date of completion of the project. The installed switch shall provide for the following features:

- Standard 19” 1U chassis and 6” in depth.
- AC Current Draw Monitoring
- Source IP Address Access Filtering/Blocking
- Remote Access using HTTP, HTTPS, Telnet and SSH
- Administrative and View-Only User Access Levels
- Standalone Calendar/Clock Timer for Each Power Outlet's Control
- AutoPing, Reboot and Event timers for each power outlet
- RS232 Master Service port and 10/100 BaseT RJ-45 Ethernet port

7.14 Wireless Access Unit

A Wireless Access Unit installed shall need to meet the following requirements, as approved by the Engineer:

- A Wireless Access Unit installed shall be configured to communicate wirelessly with a Wireless Subscriber Unit identified by the Engineer. Wireless equipment manufactured by Radwin (5000 Series), compatible with the OGL communications network and approved by the Engineer shall be installed, to enable remote communication with the traffic signal equipment. Traffic signal communications from the installed location shall than be transmitted wirelessly to the OGL communications network and shall support a minimum bandwidth of 54 mbps.
- The bid item for a Wireless Access Unit shall include supply and installation of wireless radio (Access unit), lightning protection units, 200’ of CAT5e outdoor rated shielded

cable for connection from the cabinet to the antenna, Astro bracket assemblies for mounting of the antennas, mounting plates, auxiliary communication equipment, and configuration of the communication equipment on the OGL network by a contractor certified to configure OGL wireless equipment. All mounting equipment/accessories shall match the color of the poles at the location where the unit is installed.

- Wireless radio antennas shall be mounted at a minimum of 25 feet so as to provide clear line of sight. The actual mounting location of the antenna at the location approved by the Engineer will be decided by the contractor, certified to configure OGL wireless equipment, in the field based on the best line of sight to the subscriber unit. The contractor shall coordinate the installation of the equipment with OGL staff and City of Kansas City, MO staff.
- Contractor shall test all installed communication equipment and verify available bandwidth and connectivity to the OGL communications network. A document containing the test results with the SNR value will be provided to the city staff for review. Also, an inventory containing model numbers and part numbers of equipment installed at shall be provided to the city staff. A licensed copy of the software used to configure the radios and a copy of the configuration files shall also be provided to and City of Kansas City, MO staff.
- The contractor shall be responsible for providing all equipment needed for a fully functional interconnect system. Any manufacturer provided warranty for the installed equipment shall begin from the date of completion of the project.

7.15 Wireless Subscriber Unit

A Wireless Subscriber Unit installed shall need to meet the following requirements, as approved by the Engineer:

- A Wireless Subscriber Unit installed at the intersection shall be configured to communicate wirelessly with a Wireless Access Unit. Wireless equipment manufactured by Radwin (5000 Series), compatible with the OGL communications network and approved by the Engineer shall be installed, to enable remote communication with the

traffic signal equipment. Traffic signal communications from the location shall than be transmitted wirelessly to a Wireless Access Unit and to OGL communications network and shall support a minimum bandwidth of 54 mbps.

- The bid item for a Wireless Subscriber Unit shall include supply and installation of wireless radio (Subscriber unit), lightning protection units, 200' CAT5e outdoor rated shielded cable for connection from the cabinet to the antenna, Astro bracket assemblies for mounting of the antennas, mounting plates, auxiliary communication equipment, and configuration of the communication equipment on the OGL network by a contractor certified to configure OGL wireless equipment. All mounting equipment/accessories shall match the color of the poles at the location where the unit is installed.
- Wireless radio antennas shall be mounted at a minimum of 25 feet so as to provide clear line of sight. The actual mounting location of the antenna at the location approved by the Engineer will be decided by the contractor, certified to configure OGL wireless equipment, in the field based on the best line of sight to the Access unit. The contractor shall coordinate the installation of the equipment with OGL staff and City of Kansas City, MO staff.
- Contractor shall test all installed communication equipment and verify available bandwidth and connectivity to the OGL communications network. A document containing the test results with the SNR value will be provided to the city staff for review. Also, an inventory containing model numbers and part numbers of equipment installed at shall be provided to the city staff. A licensed copy of the software used to configure the radios and a copy of the configuration files shall also be provided to and City of Kansas City, MO staff.
- The contractor shall be responsible for providing all equipment needed for a fully functional interconnect system. Any manufacturer provided warranty for the installed equipment shall begin from the date of completion of the project.